

SM-1400 Latch Check Switch Assembly & Tripping System Mechanism Adjustment



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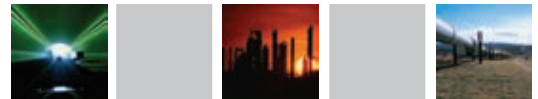
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Signal Words

As stated in ANSI Z535.4-2002, § 4.13-4.13.3 the signal word is a word that calls attention to the safety sign and designates a degree or level of hazard seriousness. The signal words for product safety signs are **“Danger”**, **“Warning”**, and **“Caution”**. These words are defined as:



DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Not stated in ANSI Z535.4-2002, § 4.13-4.13.3 as a signal word but used in this manual is **“IMPORTANT”**. This is defined as:



IMPORTANT

IMPORTANT indicates a section of the manual covering a non hazardous situation, but one where Powell feels proper attention is warranted.

Qualified Person

For the purposes of this manual, a qualified person, as stated in NFPA 70®, is one familiar with the construction and operation of the equipment and the hazards involved.

In addition to the above qualifications, one must also be:

1. trained and authorized to energize, deenergize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
2. trained in the proper care and use of personal protective equipment (PPE) such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
3. trained in rendering first aid if necessary.



Contents

Ch 1 General Information	1
A. SCOPE	2
B. PURPOSE	2
Ch 2 Safety	3
A. SAFE WORK CONDITION	3
B. SAFETY GUIDELINES	3
C. GENERAL	4
D. SPECIFIC	4
E. X-RAYS	5
F. SAFETY LABELS	5
Ch 3 Equipment Description	6
A. GENERAL	6
B. LATCH CHECK SWITCH ASSEMBLY	6
Ch 4 Installation	7
A. LATCH CHECK SWITCH REPLACEMENT AND ADJUSTMENT	7
1) Latch Check Switch Replacement	7
2) Latch Check Switch Adjustment	8
B. TRIPPING SYSTEM ADJUSTMENT	10

Figures

Figure 1	Latch Check Switch Assembly	6
Figure 2	Latch Check Switch Adjustment	7
Figure 3	Rotating Latch Check Switch Upwards	8
Figure 4	Latch Check Switch Mechanism	9
Figure 5	Feeler Gauge	11
Figure 6	Trip Armature Assembly Left View	13
Figure 7	Trip Armature Assembly Right View	13
Figure 8	Circuit Breaker Trip Roller	14

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Ch 1 General Information



WARNING

The equipment described in this document may contain high voltages and currents which can cause serious injury or death.

The equipment is designed for use, installation, and maintenance by knowledgeable users of such equipment having experience and training in the field of high voltage electricity. This document and all other documentation shall be fully read, understood, and all warnings and cautions shall be abided by. If there are any discrepancies or questions, the user shall contact Powell immediately at 1.800.480.7273.



WARNING

Before any adjustment, servicing, part replacement, or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, the power supply must be disconnected. Failure to follow this warning may result in injury or death.



IMPORTANT

Powell reserves the right to discontinue and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

A. SCOPE

The information in this service manual describes the following Latch Check Switch:

Latch Check Switch:

- BA-2RV2-A2

This device can be used in the following circuit breakers:

- PowlVac® STD
- PowlVac® CDR
- PowlVac® ASD
- PowlVac® Replacement Circuit Breakers
- PowlVac® 38kV CDR
- PowlVac-ND®

B. PURPOSE

The information in this maintenance procedure is intended to provide information required to properly replace and adjust the latch check switch described in **Ch 1 General Information, A. SCOPE** and adjust the tripping system mechanism.

This instruction bulletin provides:

1. Safety guidelines
2. Instructions for latch check switch replacement and adjustment and tripping system mechanism adjustment
3. Procedure for critical adjustments
4. Illustrations, photographs, and description of the latch check switch assembly and adjustment and tripping system mechanism adjustment

The illustrations in this document are provided as general information to aid in showing component locations only.

All photos and illustrations are shown using deenergized equipment.

**WARNING**

Be sure to follow the appropriate safety precaution while handling any of the equipment. Failure to do so may result in serious injury or death.

To the extent required, the products described herein meet the applicable ANSI, IEEE, and NEMA Standards; however, no such assurance is given with respect to local codes and ordinances which may vary greatly.



Ch 2 Safety

A. SAFE WORK CONDITION

The information in Section A is quoted from *NFPA 70E 2004 - Article 120, 120.1 Establishing an Electrically Safe Work Condition*.

120.1 Process of Achieving an Electrically Safe Work Condition

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.
2. After properly interrupting the load current, OPEN the disconnecting device(s) for each source.
3. Wherever possible, visually verify that all blades of the disconnecting devices are fully OPEN or that drawout type circuit breakers are withdrawn to the fully disconnected position.
4. Apply lockout/tagout devices in accordance with a documented and established policy.
5. Use an adequately rated voltage detector to test each phase conductor or circuit part to verify they are deenergized. Test each phase conductor or circuit part both phase-to-phase, and phase-to-ground. Before and after each test, determine that the voltage detector is operating satisfactorily.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being deenergized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

B. SAFETY GUIDELINES

Study this maintenance procedure and all other associated documentation before installing the latch check switch and performing adjustments.

Each user has the responsibility to instruct and supervise all personnel associated with usage, installation, operation, and maintenance of this equipment on all safety procedures. Furthermore, each user has the responsibility of establishing a safety program for each type of equipment encountered.

It is mandatory that the following rules be observed to ensure the safety of personnel associated with usage, installation, operation, and maintenance of these circuit breakers.

The safety rules in this instruction bulletin are not intended to be a complete safety program. The rules are intended to cover only some of the important aspects of personnel safety related to latch check switch replacement and adjustment and tripping system mechanism adjustment.

C. GENERAL

1. Only supervised and qualified personnel trained in the usage, installation, operation, and maintenance of the circuit breaker shall be allowed to work on this equipment. It is mandatory that this instruction bulletin, any supplements, and service advisories be studied, understood, and followed.
2. Maintenance programs must be consistent with both customer experience and manufacturer's recommendations, including service advisories and instruction bulletin(s). A well planned and executed routine maintenance program is essential for circuit breaker's reliability and safety.
3. Service conditions and circuit breaker applications shall also be considered in the development of safety programs. Variables include ambient temperature; humidity; actual continuous current; thermal cycling; number of operations; interrupting duty; and any adverse local conditions including excessive dust, ash, corrosive atmosphere, vermin and insect infestations.

D. SPECIFIC

1. **DO NOT WORK ON AN ENERGIZED CIRCUIT BREAKER.** If work must be performed on a circuit breaker, remove it from service and remove it from the metal-clad switchgear.
2. **DO NOT WORK ON A CIRCUIT BREAKER WITH THE CONTROL CIRCUIT ENERGIZED.**
3. **EXTREME CARE MUST BE EXERCISED TO KEEP ALL PERSONNEL, TOOLS, AND OTHER OBJECTS CLEAR OF MECHANISMS WHICH ARE TO BE OPERATED, DISCHARGED, OR RELEASED.** These

circuit breakers utilize stored energy mechanisms. These mechanisms must be serviced only by skilled and knowledgeable personnel capable of releasing each spring load in a controlled manner. Detailed information regarding these mechanisms is found in this instruction bulletin.

4. **DO NOT ATTEMPT TO CLOSE THE CIRCUIT BREAKER MANUALLY ON AN ENERGIZED CIRCUIT.**
5. **DO NOT USE AN OPEN CIRCUIT BREAKER AS THE SOLE MEANS OF ISOLATING A HIGH VOLTAGE CIRCUIT.** For complete isolation, the circuit breaker shall be in the disconnected position or shall be withdrawn completely.
6. **ALL COMPONENTS SHALL BE DISCONNECTED BY MEANS OF A VISIBLE BREAK AND SECURELY GROUNDED FOR SAFETY OF PERSONNEL PERFORMING MAINTENANCE OPERATIONS ON THE CIRCUIT BREAKERS.**
7. Interlocks are provided to ensure the proper operating sequences of the circuit breakers and for the safety of the user. If for any reason an interlock does not function as described, do not make any adjustments, modification, or deform the parts. **DO NOT FORCE THE PARTS INTO POSITION. CONTACT POWELL FOR INSTRUCTIONS.**



E. X-RAYS

When high voltage is applied across the contacts of a vacuum interrupter, there is the possibility of generation of X-rays. The intensity of the X-radiation is dependent on the peak voltage and the contact gap. At the normal operating voltage for this type of equipment, the radiation levels are negligible. At the voltages specified for testing, test personnel shall be in front of the circuit breaker such that the two layers of steel used in the frame and front cover construction are between the test personnel and the vacuum interrupters, and that the test personnel be no closer than one meter (3') from the front of the circuit breaker. **THE CIRCUIT BREAKER SHALL BE EITHER FULLY OPEN, OR FULLY CLOSED WHEN MAKING HIGH POTENTIAL TESTS. DO NOT TEST WITH CONTACTS PARTIALLY OPEN.**

F. SAFETY LABELS

The equipment described in this document has **DANGER, WARNING, CAUTION**, and instruction labels attached to various locations. All equipment **DANGER, WARNING, CAUTION**, and instruction labels shall be observed when the circuit breaker is handled, operated, or maintained.



IMPORTANT

Warning and Caution labels are located in various places in and on the switchgear and on the circuit breaker removable element. Always observe these warnings and caution labels. Do NOT remove or deface any of these warning/caution labels.

Ch 3 Equipment Description

A. GENERAL

This maintenance procedure is divided into two sections, the first section covers the replacement and adjustment procedures for the latch check switch, **Ch 4 Installation, A. LATCH CHECK SWITCH REPLACEMENT AND ADJUSTMENT**; and the second section covers the adjustment of the PowlVac® circuit breaker tripping system adjustment, **Ch 4 Installation, B. TRIPPING SYSTEM ADJUSTMENT**.



IMPORTANT

Always ensure correct adjustment of the "tripping system mechanism" components prior to performing the "latch check switch" adjustments.



CAUTION

Ensure that the control circuits are deenergized and the circuit breaker is deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed circuit breaker or a circuit breaker with the main closing spring charged.

B. LATCH CHECK SWITCH ASSEMBLY

The latch check switch (Figure 1) is located on the left side of the main mechanism frame, near the bottom of the main closing spring.

The latch check switch assembly consists of the following:

- Latch Check Switch
- Bracket Assembly

Use existing hardware to replace latch check switch:

- 6 - 32 x 1" Screws (2)
- Limit Switch Plate

Tools required:

- "Leaf Type" feeler gauges
- Allen Wrench Set
- 1/2" Open-End Wrench
- Channel or Needle-Nose Pliers
- Screwdrivers

Figure 1 Latch Check Switch Assembly





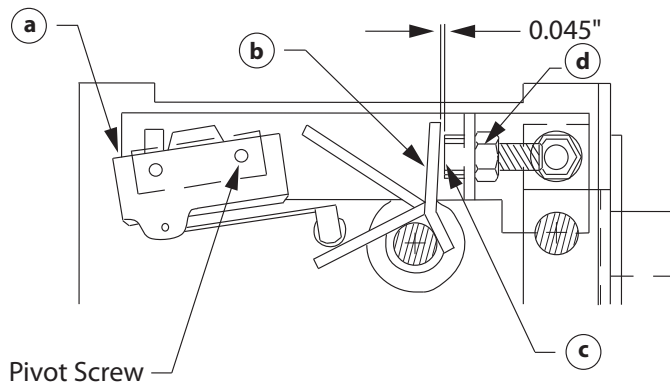
Ch 4 Installation

A. LATCH CHECK SWITCH REPLACEMENT AND ADJUSTMENT

To replace and adjust the latch check switch the main closing spring must be removed. Refer to the appropriate instruction bulletin for the specific circuit breaker for this procedure under **Ch 5 Maintenance, B. MECHANISM AREA**.

The latch check switch adjustment is not required for routine maintenance; however, the latch check switch may need to be adjusted after major overhaul, removal of the mechanism, or part of the tripping system adjustment.

Figure 2 Latch Check Switch Adjustment



- a. Latch Check Switch
- b. Latch Check Operator
- c. Secondary Trip Prop Adjusting Screw
- d. Secondary Trip Prop Adjusting Screw Nut

1) Latch Check Switch Replacement



Ensure that the control circuits are deenergized and the circuit breaker is deenergized, disconnected by means of a visible break, and securely grounded.

Perform the following steps to replace the latch check switch assembly:

1. Remove front cover of the circuit breaker.
2. Remove the main closing spring according to the circuit breaker original instruction bulletin.
3. Remove the two screws that secure the latch check switch to the mechanism. Do not lose the nut plate into which these screws are threaded.
4. Disconnect the wires from the switch, being careful to note which wire goes to which terminal.
5. Reconnect the wires to the new switch and fasten the switch in place with the screws and the nut plate which was previously removed.
6. Adjust the switch. To adjust the switch refer to steps in the following section, **Ch 4 Installation, A. LATCH CHECK SWITCH REPLACEMENT AND ADJUSTMENT, 2) Latch Check Switch Adjustment**.

2) Latch Check Switch Adjustment



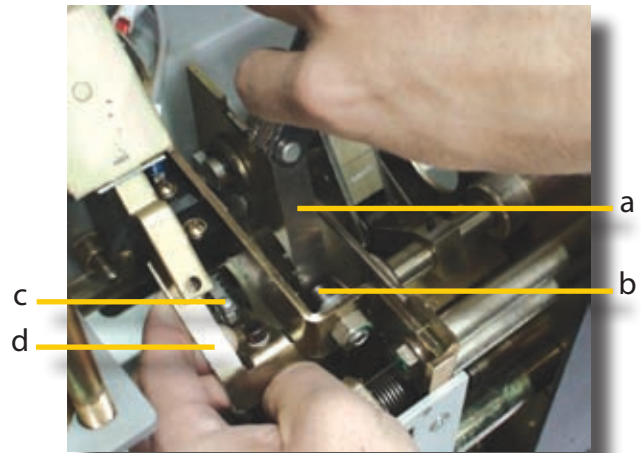
CAUTION

Ensure that the control circuits are deenergized and the circuit breaker is deenergized, disconnected by means of a visible break, and securely grounded.

Perform the following steps for latch check switch adjustment:

1. Remove the main closing spring according to the circuit breaker instruction bulletin.
2. Rotate the crank arms until the spring charge indicator displays "CLOSING SPRING CHARGED".
3. Loosen the two screws securing the latch check switch and rotate the rear of the latch check switch downward to the end of its travel. The latch check switch contacts are now "OPEN".
4. Insert a 0.045" gauge (Figure 3, a) between the secondary trip prop adjusting screw (Figure 3, b) and latch check operator (Figure 3, c). Rotate the latch check switch upwards until the contacts close. (An audible click of the contact's closing will be heard.) At the position where the contacts close, hold the switch and retighten the two screws securing the latch check switch. Remove the gauge.

Figure 3 Rotating Latch Check Switch Upwards



- a. 0.045" Feeler Gauge
- b. Secondary Trip Prop Adjusting Screw
- c. Latch Check Switch Arm
- d. Latch Check Operator

5. To confirm that the latch check switch is properly set, slowly depress and release the manual trip operator to verify that the latch check switch OPENS and CLOSES properly. An audible click of the contacts will be heard. The latch check switch contacts will OPEN as the latch check operator is moved by the manual trip operator away from the secondary trip adjusting screw. Slowly withdraw the manual trip operator and the latch check switch contacts should close when the latch check operator's secondary trip stop tab is between 0.045" to 0.015" away from the rear edge of the secondary trip prop adjusting screw.



IMPORTANT

The gap should always be initially set to 0.045". The 0.045" to 0.015" reference is the allowable working gap tolerance measured during breaker operation.

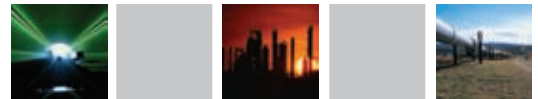
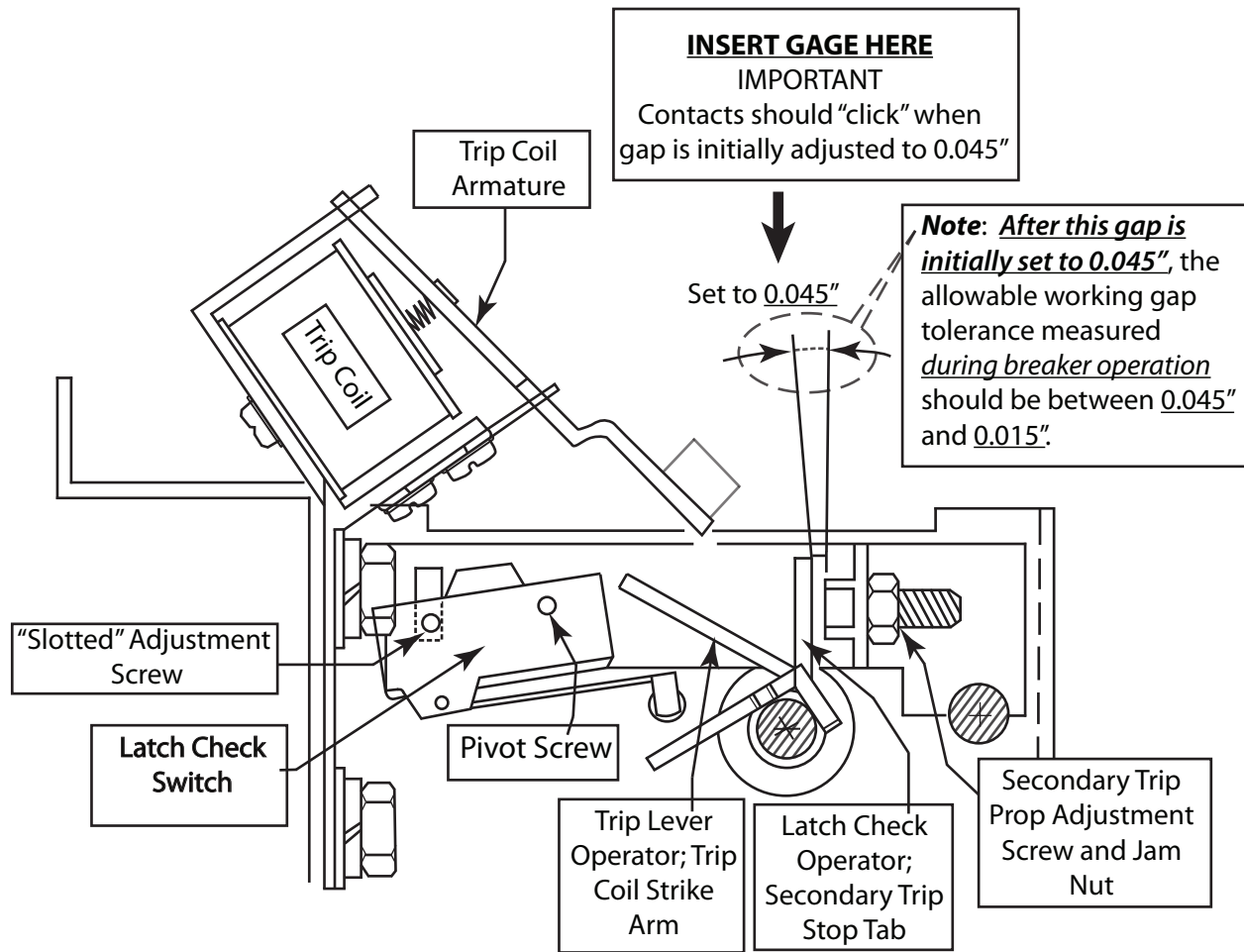


Figure 4 Latch Check Switch Mechanism



6. Depress the manual close operator and rotate the crank arm until resistance is felt.
7. Depress and hold the manual trip operator inward and rotate the crank arms until the spring charge indicator displays "CLOSING SPRING DISCHARGED".
8. Reinstall the circuit breaker main closing spring assembly.
9. Operate the circuit breaker electrically several times to ensure the switch functions properly.

Note: *The latch check switch replacement and adjustment are now complete.*

B. TRIPPING SYSTEM ADJUSTMENT

To adjust the PowlVac® Tripping System perform the following steps:

1. Ensure the circuit breaker is in the OPEN position and all springs are DISCHARGED.
2. Remove the circuit breaker front cover.
3. Install a secondary disconnect override device to allow manual closing and opening of the breaker. Refer to *step 3a or 3b* depending on the circuit breaker type.

a) Standard (STD) PowlVac Breaker:

- Install secondary disconnect override device
- Depress and hold the trip button
- Pull the racking access cover downward to expose the racking drive shaft
- Insert the racking handle and rotate clockwise until a positive stop is felt. There should be very little resistance to the turning effort until the end of travel position is reached. The positive stop position should be easily detectable. Do not apply excessive force to the racking handle

Note: *The breaker position indicator will change positions, but since the front cover has been removed, it will not accurately indicate the "connected" position.*

b) Closed Door Racking (CDR) PowlVac Breaker:

- Install secondary disconnect override device
- Manually rotate the racking input shaft clockwise until a positive stop is felt. There should be very little resistance to the turning effort until the end of travel position is reached. The positive stop position should be easily detectable

Note: *The breaker position indicator will change positions, but since the front cover has been removed, it will not accurately indicate the "connected" position.*

Note: *Steps 3a and 3b ensure that the secondary disconnect override device is mechanically held in the secondary disconnect receptacle during opening and closing of the circuit breaker.*



CAUTION

This maintenance procedure requires charging the stored energy spring and subsequently closing and opening the circuit breaker. Exercise extreme caution to make sure that all personnel, tools, and other objects are clear of the moving parts or the charged springs. Failure to do this may cause serious damage or injury to the circuit breaker and personnel.



4. Loosen the secondary trip prop adjusting screw locking nut (Figure 2, d) several full turns.



CAUTION

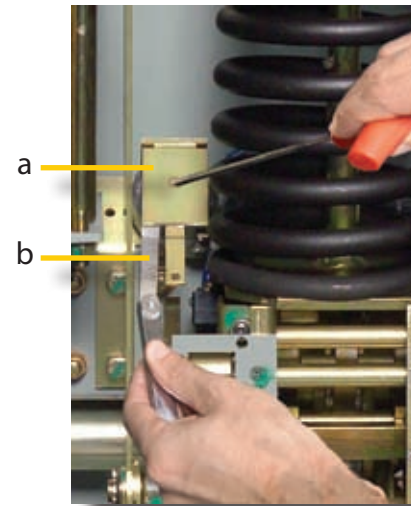
DO NOT allow the secondary trip prop adjusting screw to turn while loosening the locking nut. Failure to observe this will severely damage the mechanism.

5. Manually charge the circuit breaker main spring.
6. Manually CLOSE the circuit breaker.
7. Slowly turn the secondary trip prop adjusting screw (Figure 2, c) clockwise in $\frac{1}{8}$ turns (45°) increments until the breaker trips OPEN. Carefully note the rotational position of the tool used to turn the adjusting screw at the moment the breaker opens. Do NOT turn the screw any further clockwise after the breaker operates.
8. Turn the secondary trip prop adjusting screw (Figure 2, c) counterclockwise $1\frac{1}{2}$ full turns from the position noted in step 7.
9. While preventing the secondary trip prop adjusting screw from turning, securely tighten the secondary trip prop adjusting screw locking nut (Figure 2, d).

Note: The secondary trip prop screw adjustment is now complete.

10. To begin adjustment of the trip coil armature gap, manually charge the main closing spring using the manual charge handle.
11. Manually CLOSE the circuit breaker.
12. Using leaf type feeler gauges with a total of 0.090" thickness selected, position the feeler gauge below the trip coil armature as shown in Figure 5.

Figure 5 Feeler Gauge



- a. Trip Coil Armature
- b. Feeler Gauge

13. Slowly depress the trip coil armature using the manual charge handle. Position the handle as shown in Figure 5. Depress the handle until the armature contacts the feeler gauges. The circuit breaker should not trip.

Note: It is important to avoid "tilting" the trip coil armature. Tilting the armature by applying a load to the right of the feeler gauges will produce incorrect results.

14. Choose one of the following steps according to the results of the TRIP status from step 13:
 - i. If the circuit breaker TRIPPED during the test performed in step 13, increase the gap between the trip coil armature and the trip lever by bending the lever downwards slightly using channel lock pliers or a small crescent wrench. Repeat steps 10 through 13 until the breaker stays CLOSED with a 0.90" trip coil armature gap setting.

Note: Bend the trip lever downward in very small increments. This process may take several attempts.

- ii. If the circuit breaker did NOT TRIP during the test performed in step 13, reset the feeler gauges with 0.030" selected and position the feeler gauge.
15. Slowly depress the trip coil armature using the manual charge handle. Depress the handle until the armature contacts the feeler gauges. The circuit breaker should trip.

Note: It is important to avoid "tilting" the trip coil armature. Tilting the armature by applying a load to the right of the feeler gauges will produce incorrect results.

16. If the circuit breaker did NOT TRIP during the test performed in step 15, remove the feeler gauges and trip the breaker. Decrease the gap between the trip coil armature and the trip lever by bending the trip lever upwards slightly using channel lock pliers or a small crescent wrench. Repeat steps 10, 11, & 15 and adjust until breaker trips with a 0.030" trip coil armature gap setting.

Note: Bend the trip lever upward in very small increments. This process may take several attempts.

17. Repeat steps 10 through 16 until the breaker does NOT TRIP with the 0.090" gauge inserted in the trip coil armature gap and DOES TRIP with the 0.030" gauge inserted into the trip coil armature gap.

**WARNING**

When any maintenance procedure requires the opening or closing of the circuit breaker or the charging of any of the stored energy mechanism springs, exercise extreme caution to make sure that all personnel, tools, and other miscellaneous objects are kept well clear of the moving parts or the charged springs. Failure to do this may cause serious damage or injury to the circuit breaker or personnel.

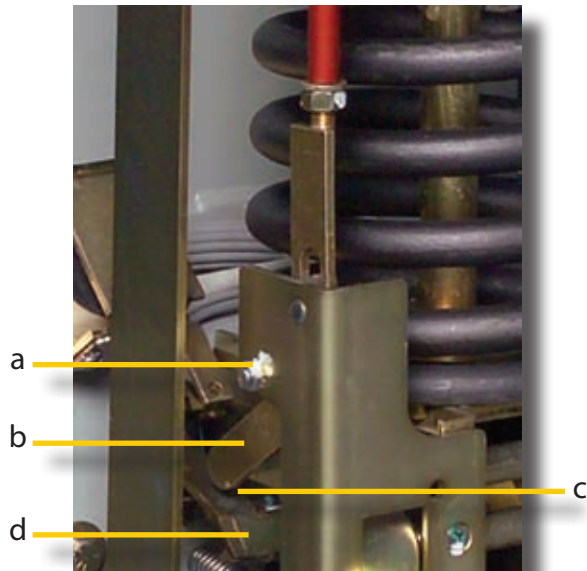
If tripping system adjustment is being made on 5kV or 15kV circuit breaker, manually CLOSE and TRIP the circuit breaker so that all springs are discharged then proceed to **Ch 4 Installation, A. LATCH CHECK SWITCH REPLACEMENT AND ADJUSTMENT, 2) Latch Check Switch Adjustment.**

If tripping system adjustment is being made on 27kV or 38kV circuit breaker then proceed to step 18.

18. Manually charge the main closing spring using the manual charge handle. Refer to the appropriate circuit breaker instruction bulletin, **Ch 4 Installation, D. PLACING THE CIRCUIT BREAKER INTO SERVICE, 4) Mechanical Operation Check.**



Figure 6 Trip Armature Assembly Left View



- a. 10 -32 Pan Head Kep Nut
- b. Trip Armature Actuator
- c. 0.040" Air Gap Between the Trip Armature Actuator & the Latch Check Operator
- d. Latch Check Operator

19. If there is an air gap of 0.040 inches (Figure 6, c) between the trip armature actuator (Figure 6, b) and the latch check operator (Figure 6, d) of 0.040 inches, then proceed to step 21.

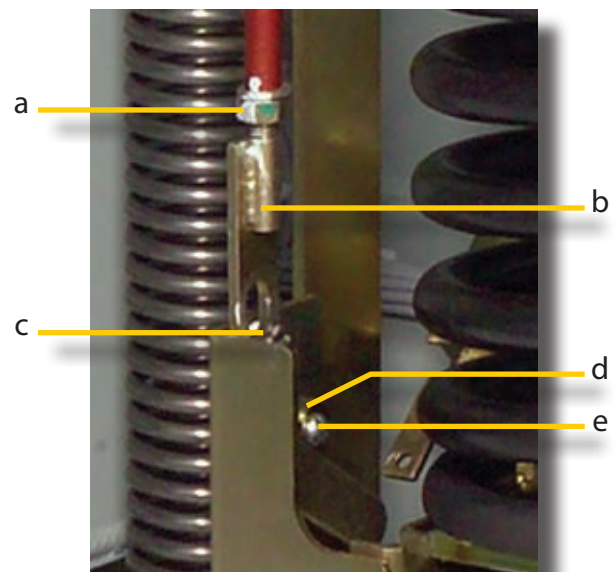
- a. If there is no air gap, loosen the 10-32 pan head cap screw (Figure 7, e) and nut. Rotate the eccentric (Figure 7, d) to obtain the 0.040 inch gap and tighten the hardware.
- b. Hold the trip armature actuator assembly (Figure 7, b) and loosen the $\frac{5}{16}$ hex nut (Figure 7, a).
- c. Remove the x-washer (Figure 7, c) and flat washer from the push to trip support bracket rivet.
- d. Remove the trip armature actuator assembly from the push to trip support bracket and let it suspend from the top of the circuit breaker.

- e. Rotate the trip armature actuator to achieve the desired height of $1.676'' +0/-0.06''$ (Figure 8, b) from the top of the trip roller (Figure 8, a) to the top of the circuit breaker frame (Figure 8, c).
- f. Reinstall the trip armature actuator assembly to the push to trip support bracket.

Note: Dimensions can only be measured when the actuator assembly is installed.

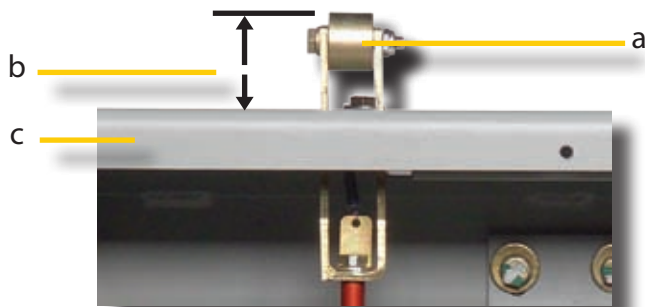
- g. Hold the trip armature actuator and tighten the $\frac{5}{16}$ hex nut.
- h. Replace the x-washer and flat washer that was removed in step c.

Figure 7 Trip Armature Assembly Right View



- a. $\frac{5}{16}$ - 18 Hex Nut
- b. Trip Armature Actuator Assembly
- c. X-Washer
- d. Eccentric
- e. 10 - 32 Pan Head Cap Screw

Figure 8 **Circuit Breaker Trip Roller**



- a. Circuit Breaker Trip Roller
- b. 1.676" +/-0.06" Desired Trip Roller Height
- c. Top of Circuit Breaker Frame

20. Manually CLOSE and TRIP the circuit breaker so that all springs are discharged.
21. Perform the latch check switch adjustment described in section, **Ch 4 Installation, A. LATCH CHECK SWITCH REPLACEMENT AND ADJUSTMENT, 2) Latch Check Switch Adjustment**

Note: The trip coil armature adjustment is now complete.

22. Remove the secondary disconnect override device. Refer to *step 22a or 22b* depending on the circuit breaker type.

a) Standard (STD) PowlVac® Breaker:

- Depress and hold the trip button
- Pull the racking access cover downward to expose the racking drive shaft
- Insert the racking handle and rotate counterclockwise until a positive stop is felt. There should be very little resistance to the turning effort until the end of travel position is reached. The positive stop position should be easily detectable. Do not apply excessive force to the racking handle

- Remove the secondary disconnect override device

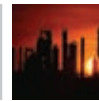
Note: The breaker position indicator will change positions, but since the front cover has been removed, it will not accurately indicate the "disconnected" position.

b) Closed Door Racking (CDR) PowlVac Breaker:

- Manually rotate the racking input shaft counterclockwise until a positive stoop is felt. There should be very little resistance to the turning effort until the end of travel position is reached. The positive stop position should be easily detectable
- Remove the secondary disconnect override device

Note: The breaker position indicator will change positions, but since the front cover has been removed, it will not accurately indicate the "disconnected" position.

23. Replace the circuit breaker front cover.



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